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TYPE RYH-111 CARBON-PILE AUTOMATIC VOLTAGE REGULATOR ASSEMBLY AND MAINTENANCE INSTRUCTIONS

1. Design

Carbon-pile voltage regulators directly affect the excitation of the machine under their control. The control and measurement circuit consisting of the regulator coil and an auxiliary type VS (BC)-240 resistor is connected to the generator terminals. The carbon rheostat consisting of two or four piles made up of thin carbon washers is connected in series into the excitation circuit of the machine under control. The ohmic resistance of the carbon piles decreases with the growth of pressure on them.

The design of the voltage regulator is shown in Fig. 1.

The force with which the electric magnet attracts the armature (4) grows with the increase of voltage on the generator terminals. The force of balance coil (9) acts counter to the electromagnetic effort and to the reaction of the carbon pile. At the given voltage these forces are mutually balanced regardless of the position of the armature. When the voltage grows, the increasing electromagnetic force attracts the armature thereby reducing the pressure on the carbon piles. The resistance of the carbon rheostat increases and the excitation current diminishes until the equilibrium of forces acting on the armature is restored. If the voltage on the terminals decreases, the force of the balance coil prevails. The pressure on the carbon piles increases and the resistance falls, the excitation current mounting until

equilibrium of forces is regained. This indicates recovery of pre-set voltage.

The load of the carbon rheostat (counted in watts) should never exceed the values allowed for the given type and written on its name-plate. When heated for prolonged periods to temperatures above normal the carbon piles gradually oxidize and decay.

Voltage regulators give satisfactory performance in rough sea conditions. The movable inner parts need not be secured during transportation.

In devices subject to lurching and rolling it is better to mount the regulator so that the plane of its base plate should stand perpendicular to the lurch and rolling axis. When installing the unit, see that the plate should not warp and if necessary level it by placing washers under its supports.

II. Connection

Before connecting the regulator remove the seal, inspect the regulator and replace all washers cracked during transportation. The spare washer should be inserted in the branch from which the defective one was removed. Replace the washers after loosening the carbon piles (with the armature in its lower position) having previously removed one of the insulating bars (14, Fig. 1). Having replaced the defective washers, check the resistance of the carbon resistor according to the values given on

the name-plate for the rheostat in cold condition. Measure the resistance by means of an ammeter and voltmeter, connecting a high ohmic voltmeter in parallel to the rheostat at the current intensity of 0.1 ampere and with cold carbon piles. After that the regulator may be put into operation.

Fig. 2 shows the principal diagram of connection between the regulator and the d.c.generator.

During automatic regulation the shunt rheostat in series with the carbon piles must be shortened. The shunt rheostat is introduced only when the regulator is defective or being tested. Regulator performance is tested as follows.

Set the generator running free so that the armature should be drawn approximately up to the horizontal lever position, maintaining the voltage at almost given value. Then gradually introduce the resistance of the shunt rheostat, watching the voltmeter and the position of the armature. During the downward and upward movement of the armature the generator voltage should remain almost stable. Regulator performance is considered satisfactory, if the stabilized voltage during the whole movement of the armature does not decline from the mean value more than ± 2% (not counting the intermediate period).

If, during the armature's slow upward movement the voltage is low, and during attraction high, it indicates rubbing. In such cases the regulator should be checked according to directions given in part IV.

If the voltage level maintained by the regulator alters both during armature attraction and release, the regulator should be adjusted according to the description given in part V.

If with the armature fully attracted the generator voltage is higher than required, it means that the maximum resistance of the carbon pile is insufficient, The remedy in such cases is either to introduce an additional resistance in series with the carbon piles or to choose a regulator with a higher maximum resistance.

If under high loads, with the armature occupying its upper position, the voltage falls, it is a sign that too much resistance has been introduced in the excitation circuit, or the regulator is wrongly chosen.

To cut off the regulator introduce a shunt rheostat and shorten the leads brought out to the carbon piles of the automatic regulator,

III. Voltage Adjustment

The voltage value maintained by the regulator, depends on the tension of balance spring 9 (Fig. 1), and the value of the additional resistance introduced in the control coil circuit.

The voltage setting is adjusted by altering the value of the additional resistance (adjustment rheostat VS-240) included in the regulator control circuit.

To increase generator voltage setting it is necessary to increase additional resistance VS-240. By altering the additional

resistance it is possible to adjust d.c.generator output voltage within the limits of 90-110% of the rated value given on the regulator name plate.

IV. Inspection and Repair

Inspect the regulator before connecting, especially having noticed a defect or after long service (about 1000 hours) or prolonged conservation. Regulators should not be stored in dusty or damp rooms.

The carbon piles should be undamaged and of approximately equal height. The rod should press on all piles with equal force. When the armature of the electromagnet is fully lowered the carbon washers must be relaxed; when it is raised they must be considerably tightened. Each pile is under a pressure of approximately one kilogram.

The flexible conductors connecting the terminals with the silver washers inserted in the piles, must not touch the supporting bars and must not be under tension, otherwise, when the carbon pile is relaxed the silver washers will shift and hinder full relaxation.

The armature should not touch the magnetic conductor.

The air clearances should be equal.

The effect of parasitic friction in any of the rubbing parts of the regulator on the work of the latter may be judged from the diversion of the generator voltage from the pre-set value.

To avoid unnecessary friction and warping, do not disassemble the regulator. When inspecting fixation pay attention to the tightness of screw, especially those of the plate springs. Before replacing the carbon washers remove one of the insulating bars 14 (Fig.1).

V. Adjustment

The regulator will keep the predetermined voltage normally stable in all generator operating conditions if the force attracting the armature together with the force of reaction of the carbon pile equal the force of balance spring 9 (Fig.1) in all armature positions from extreme upper to lower (i.e. at the alteration of carbon resistance from maximum to minimum). This is achieved by adjustment which is done at the plant-producer. Here are the main methods of adjustment.

a) Tightening of carbon piles

Correct tightness of carbon piles 2 (Fig.1) is checked by the regulator characteristic chart (see part II). If during the first half of the armature's downward movement, the tension of the balance spring is equilibrated at the given voltage (i.e. the regulator maintains correct voltage) but during further armature movement equilibrium is achieved with greater voltage (which is the greater, the nearer the armature is to its lower position), it means the piles are not tight enough. The carbon piles may loosen after prolonged service so that minimum carbon resistance increases.

If with the armature in its upper position, equilibrium is attained at low voltages, it means that the carbon piles are tightened too much.

The tightness of the carbon piles is adjusted by nuts (12, Fig.1) which are turned by means of an 8 mm spanner.

b) Adjustment of the balance springs.

Balance spring 9 (Fig.1) opposes armature attraction. If during the latter equilibrium is attained with gradually increasing voltages, the action of the spring must accordingly be weakened by shifting the end of the spring towards the core with the help of nuts 13 (Fig.1), the tension of the spring being somewhat relaxed by the same nuts.

If during armature attraction equilibrium is attained with gradually dropping voltages, the action of the spring must be reinforced by shifting the end of the spring away from the core after which the tension of the spring slightly increases.

In ordinary operational conditions it is difficult to adjust the balance spring properly. Therefore such adjustment should only be carried out under emergency. This work should be assigned to highly skilled personnel and carried out very carefully.

ELECTRIC MACHINES OF PN-10 TYPE
DESCRIPTION AND MAINTENANCE INSTRUCTIONS

CONTENTS

Part I

GENERAL

D.C. electric machines of the PN-10 type can operate both as motors and as generators. The electric machines of this type are splashproof.

Electric motors are designed for long periods of operation.

The normal rotation of the electric machines is counterclockwise (left), viewing from the drive end.

According to the connection diagram shown in Fig. 2, the leads of the motor windings are brought out to the terminal panel with the following designations:

1. Armature winding Ja1 /Я1/ - Ja2 /Я2/
2. Shunt winding Sh1/Ш1/ - Sh /Ш2/
3. Series winding S1 /С1/ - S2 /С2/
4. Commutating poles winding D1 - D2

The machine overall dimensions are given in Fig. 4.

Part II

DESCRIPTION

The electric machine of the PN-10 type consists of the following assemblies (Fig. 1).

A. Magnetic System

The magnetic system consists of the following parts: steel frame (cast or welded) 25 with lifting eye 22; main pole ,

consisting of core 20 and winding 19; commutating pole, consisting of core 23 with winding 24. The main pole core is made of 0.5 - 1 mm sheet steel. The commutating pole core is made of solid steel.

The magnetic system of the PN-10 type machines has two main and one commutating poles.

B. Armature and Commutator

The machine armature consists of a stack of laminated iron 21, commutator 14, fan 27 and shaft 32 onto which bearings 3 with casings 6 and 29 are fitted.

The machines of the PN-10 type have a drop - in armature winding. It is assembled in half-closed grooves and fastened by wedges and by wire bandages at head parts.

In the machines of the PN-5 - PN-85 types the armature stack is pressed between two clamp rings 18.

Commutator 14 is made of electrolytic copper bars with mica insulation. It is tightly pressed on bushing 15 between cone rings 9 and fitted onto a shaft.

C. Rocker and Brush Holders

Brush rocker is a split ring 8 with lugs for fastening pins 11 or brackets on which are mounted brush holders 13 with carbon brushes. The brush holders are adjusted so that the

spacing between the brush holder and the commutator is 2-3 mm.

D. Bearings

Single row ball bearings 3 identical on both shaft ends are used in the machines of the PN-10 type.

The bearings are inserted into casings 6 and 29 and closed by caps 4 and 31. The casings are fastened to housings 10 and 26 by bolts through face washers 5 and 30.

E. Bearing Housings

The bearing housings are made of steel. The commutator end housing has windows for inspection and maintenance of the commutator and brush assembly.

The housing is covered with a so-called "cover-band" (1) made of a steel sheet perforated for air circulation. Felt 12 is riveted to the cover band for better packing. Located above the perforation are peaks 35 designed to protect the commutator and brush assembly against vertically falling drops of water when the motor is pitched at 45° to the vertical line.

The cover band may be turned around the housing circumference so that the windows of the cover band are brought in line with those of the housing; this provides free access to the commutator and brush assembly.

The lower part of the housing has a window for air cooling protected by a perforated cover. At the drive end the sides of the housing have windows covered with perforated iron for outlet

of heated air. Peaks are located above the perforation.

At the commutator end the housing has packed inspection windows, at the drive end the housing is blind.

The housings have holes for lubricating the bearings. Normally the holes are closed by caps 7 and 28.

F. Terminal Box

Usually the terminal box is mounted on the left side of the frame, viewing from the drive end. The box houses two double capacitors 36 and terminal panel 37 with terminals 38. A machine connection diagram is attached to the inside of lid 39.

G. Ventilation

For cooling the machine centrifugal fan 27 is mounted on the shaft consisting of a disc and a ring with impellers riveted radially between them.

When the armature rotates the fan sucks in the cooling air through the commutator end. The air streamlines the commutator, brush assembly, armature, pole coil surfaces and, when heated, is discharged from the machine.

Waterproof machines are cooled by surface heat loss.

H. Insulation

The winding insulation of the electric machines is made of waterproof insulating materials and is impregnated by

special varnishes.

4. Frame Grounding

The frame of the electric machines is grounded by means of pin 34 (fixed on the ribs or on the feet of the machine) to which a grounding conductor is secured.

5. Protection from Radio Interference

Protection from radio interference is achieved by capacitors 36. The frame has special screws 33 for grounding the lead screen.

P a r t III

MAINTENANCE INSTRUCTIONS

1. General Supervision

1. See that the machine and the room are kept clean and that there are no foreign things on and inside the machine.

2. See that the machine does not vibrate, that the lids, cover bands, shutters, etc. are properly secured.

3. See that the load and temperature do not exceed the rated values.

4. Check the value of the insulation resistance with respect to the frame.

5. See that the machine is grounded securely.

B. Preparation for Starting

Before starting the machine after assembly or a long stand-still period:

1. Check the connection of the electric drive elements according to the diagram;

2. Remove dust, dirt and foreign things from the outer parts of the machine, blow it by dry compressed air (with pressure not exceeding 2 atmospheres), or by hand operated bellows. Check the bearing lubricating grease. See that the commutator is clean and in good repair;

3. Check the pressure of the brushes and their contact with the surface of the commutator (collector rings) and see that the brush leads are fastened securely. Check the spacing under each pole with a clearance gauge and compare it with the rated data; correct the faults, if any;

4. See that the leads are connected according to the diagram and the supply voltage corresponds to that indicated on the name plate. Check with a 500v megohmmeter the insulation resistance with respect to the frame.

The machine should not be started with the insulation resistance below 0.1 megohm (the normal resistance should not fall below 0.5. megohm).

C. Starting and Stopping the Generator

To start the generator do the following:

1. Check the readiness of the circuit (all switches cut

out, the distribution apparatus in good repair, the exciting circuit shunt regulator set at the minimum voltage);

2. Let the generator reach its rated speed;

3. Cut in the exciting circuit knife switch, and by means of a shunt regulator set the generator voltage at the rated value;

4. Cut in the main switch at the minimum load and gradually increase the generator load;

5. In case of defects the generator should be stopped, the defects located and corrected.

To stop the generator do the following:

1. Minimize the generator load by reducing the generator voltage by means of a shunt regulator;

2. Cut out the main switch and stop the generator.

D. Starting and Stopping the Electric Motor

Before starting the electric motor check the readiness of the mechanism (see part III, section B), manually turn the armature by the coupling, then connect the electric motor to the supply system and when using:

1. A starting rheostat - smoothly, without jerking and without halting at intermediate positions turn the rheostat handwheel from the extreme left position "Off", "Выключено"/ to the extreme right "On" /"Включено"/ and then turn the handwheel of the speed governor, if available, in the direc-

tion indicating "Higher speed" /"Выше"/ until the speed reaches the required value;

2. A starting - and - regulating rheostat - smoothly, without jerks turn the handwheel clockwise as far as the "Regulation" /"Регулировка"/ position and then further in the same direction until the speed of the electric motor reaches the required value;

3. A control post - turn the handle to the extreme position;

4. A command - controller - turn the handwheel to the extreme position of the controller;

5. A magnetic starter - press the "Start" /"Пуск"/ button.

To stop the electric motor when using:

1. A starting rheostat and speed governor - slowly, without jerks turn the governor handwheel counter-clockwise as far as it will go, and quickly turning the handwheel on the starting rheostat return the contact brush to the extreme left "Off" position;

2. A starting-and-regulating rheostat - turn the handwheel to the extreme left "Off" position, slowly along the regulating section and quickly along the starting section of the rheostat;

3. A control post - return the handle to the zero position;

4. A command-controller - turn the handwheel or return the handle of the command-controller to the zero position ;

5. A magnetic starter - press the "Stop" button. After stopping the electric motor see that it is ready for immediate starting.

E. Maintenance in Operation

For normal operation of the machine strictly observe the instructions given in part III, section A.

Not less than once a week carry out the instructions given in paragraph 2, section B, part III. Every electric machine has a log for filling in all information relevant to its operation.

F. Maintenance during Short Time Stand-Still

During short time stand-still the electric machine should be periodically inspected:

1. Make sure that the inside and outside of the machine are not damp and are free of dirt, oil, and foreign matter;

2. Blow the machine by dry compressed air or by a hand bellows;

3. Check the condition of the wire contacts, commutator, brushes and brush holders, the setting of the rocker by the plant mark;

4. Measure the insulation resistance.

G. Maintenance during Long Time Stand-Still

1. Make an internal and external inspection of the machine and correct all the defects found.

2. Blow the machine and wipe the brush holders, commutator and collector rings with cotton rags.

3. Wrap the commutator in a 0.1 - 0.3 mm pressboard.

4. Insert the carbon brushes into the brush holders.

5. Clean the surface of the rings with cotton cloth soaked in petrol, wipe them, coat with colour varnish using a soft brush and dry them for 20 minutes at 15°-20°C.

6. To prevent dust from penetrating inside the machine tightly close the inspection covers above the commutator, put a pressboard or cable paper both under the commutator housing cover band and the protecting screens of the housing at the drive end and seal up the ventilation screens with cable paper at the face end of the commutator housing. Coat the name plate with technical vaseline and cover it with paper.

H. Drying the Electric Machine

Drying by hot air is done when the resistance of any circuit of the machine is below 0.1 megohm. During the process of drying the windows in the housings should be open. The insulation resistance is measured with a megohmmeter, the temperature of the armature and the exciting coils with a thermometer, the mercury ball of which is wrapped in foil and covered with cotton wool or felt.

During the first 2-3 hours the temperature of the windings should not rise above +50°C, and after 6-8 hours of drying - above +70°C.

During the process of drying the insulation resistance first begins to drop due to the evaporation of moisture from the machine, then it begins to increase and finally becomes constant or increases inconsiderably. Do not stop drying if the insulation resistance continues to fall.

When the insulation resistance value becomes constant the drying should be continued for another 4-5 hours, and if after that the insulation resistance varies but slightly the process of drying may be considered completed.

Drying by electric current is done when the insulation resistance is equal to or above 0.1 megohm. During the process of drying the housing windows should be open. For more intensive evacuation of humid air the machine should be rotated or a separate fan installed to blow the machine frame.

When drying by outside source of current supply cut out the armature circuit, securely ground the frame and connect the exciting winding to the supply system.

The voltage in the exciting winding is adjusted in such a way that the duration of the drying process and the maximum allowable temperatures are the same as when drying by hot air.

The maximum temperature of the windings should not

exceed +70°C.

When the drying is done with the machine rotating the latter should be periodically stopped to measure the temperature and the insulation resistance of the windings.

An inconsiderable further increase of the winding insulation resistance will indicate that the drying process should be stopped.

If drying by the exciting current does not raise the insulation resistance to the allowable value (not below 0.5 megohm) the drying can be continued by passing the current through a series resistor into the armature circuit See that the current does not exceed 50-60 per cent of the rated value. In this case the exciting winding is cut out.

The process of drying is controlled as indicated above.

When drying by short circuit current the armature is shorted through the coils of the commutating poles. The frame of the machine is securely grounded and the series winding is cut out.

The maximum resistance in the shunt winding is adjusted by turning the handwheel of the field regulator. The field current is adjusted by turning the regulator handwheel in the direction of resistance reduction. When being dried the machine should not spark and the short circuit current should not exceed the rated value.

The duration of drying and maximum allowable temperatures are the same as when drying by hot air.

I. Maintenance of Separate Machine Units

General Rules

1. Commutator

Normally the commutator should have a glossy surface without scratches and burned spots.

During long periods of operation under load, when there is no sparking, a thin firm crust is formed on the commutator surface which protects the commutator from attrition. This crust should be preserved, therefore grinding the commutator surface with glass paper is prohibited. The grinding of the commutator and collector rings is done only in case rings, rough or burned spots appear on their surfaces. The grinding of the machine in operation should be done only by No. 0 glass paper slightly greased with vaseline.

The methods and procedure of commutator maintenance are given in Fig. 3, however, it should be borne in mind that when the commutator is ground, grooved or turned the front part of the armature winding should be papered up to the bandages and the commutator risers, down to the bottom to prevent the filings and copper dust from penetrating inside the armature.

When turning the armature, bearings should be placed in the lathe supports, but not turned with the armature bearings clamped between the centres.

After machining blow the commutator and collector

rings by dry compressed air.

2. Brushes

The brushes should contact the commutator and collector rings with their entire working surface, which should be glossy.

Brush pressure on the commutator and collector rings is checked with a dynamometer and should be about 0.15 - 0.20 kg cm^2.

The clearance between the carbon brush and the brush holder sleeve should not exceed 0.2 mm. Brushes worn down to 20mm in length and accidentally damaged brushes should be replaced by spare ones of the same type only.

The brushes are ground in by means of a strip of No. 0 and 00 glass paper wound around the commutator (the strip width is equal to the commutator length). The strip ends are overlapped in the direction of the normal rotation of the machine.

The brushes are ground in by manually turning the armature in the direction of its normal rotation until their surface fully matches the commutator surface.

Grinding in with emery and carborundum paper is prohibited, since emery grains eat into the brushes and scratch the commutator, which may cause sparking.

After grinding in the brushes the commutator, collector rings and brush holders are cleaned of carbon dust and the entire machine is blown with dry compressed air. When blowing see that dust does not get inside the machine.

After replacing brushes on the commutator or collector rings grind them to the commutator at a reduced load (1/4 or 1/3 of the rated load) until their surfaces become glossy.

3. Bearings

The bearings of the splashproof machines should not be heated above +70°C and of the waterproof type above +85°C. During the operation of the machine, the noise of the bearings should be even. If the bearing overheats or makes a loud

uneven noise that becomes a whistle, knock, etc. it should be examined.

In case cracks, uneven wear or other defects are noticed on the surface of the balls or rings, the bearings should be replaced by spare ones of the same number.

The defective bearing is removed from the shaft when cold by means of a strainer after the armature has been removed.

After preliminary heating up to +80° -90°C in an oil bath the spare bearing is washed in petrol and fitted onto the shaft.

The bearing is fitted onto the shaft by means of a tube. Type 1-13 consistent grease is filled up to 2/3 of the chamber formed between the inner and outer caps.

When handling the bearings carefully protect them against dust and moisture as well as against heavy knocks on the inner ring. It is categorically prohibited to knock on the outer ring of the bearing. The lubricating grease is changed every 2,000 - 2,500 hours of operation, but not less than once a year.

J. Troubles and Remedies

Possible cause	Remedy
1. Excessive sparking of the brushes	
a) The brushes are not properly ground in	Grind in the brushes and run them in at a low load (see part III,

Possible cause	Remedy
	section I, paragraph 2).
b) The brushes are not properly pressed against the commutator or their pressure is uneven.	Ensure normal brush pressure (0.15-0.20 kg cm^2) by replacing the brush holders.
c) The brushes are badly worn down or their type does not meet the technical requirements.	Replace the brushes by new ones of the corresponding type.
d) The commutator is rough, dirty, not round etc.	Clean or grind the commutator (see part III, section I, paragraph 1).
e) The mica between the commutator segments juts out.	Groove and grind the commutator
f) Excessive load.	Reduce the load
g) Loose mounting of the machine.	Tighten up the bolts and nuts fixing the machine feet.
l) Short circuit in the commutating pole winding.	Find the defective coil and correct the short circuit.
i) The exciting windings are wrongly connected.	Connect them according to the diagram.
j) Short circuit between the main pole turns.	Replace the coil of the main pole.

Possible cause	Remedy
2. The commutator overheats	
a) The wrong type of brushes is employed.	Replace the brushes by new ones of the corresponding type.
b) The brushes are too tightly pressed against the commutator.	Ensure normal pressure (0.15 - 0.20 kg cm^2) by replacing the brush holders.
c) The brushes are improperly installed.	Install the brushes properly (see part III, section I paragraph 2).
3. The Armature Overheats	
a) Excessive load.	Reduce the load.
b) Too high voltage.	Reduce the voltage to the rated value.
c) Short circuit of one of core sections of the armature winding; short circuit between two commutator bars; short circuit of the armature winding through the bandages.	Replace the electric machine by a spare one.

Possible cause	Remedy
4. The exciting coils overheat	
a) Short circuit between turns of the shunt coils.	Find the defective coil and replace it by a spare one
b) Excessive exciting current caused by a defective field regulator.	Check the field regulator and correct the defect.
5. The Electric Machine does not Rotate	
a) Open circuit (fuses blown, break in the armature winding or coils).	Replace the fuses, correct the break or replace the electric machine by a spare one.
b) Excessive starting load.	Reduce the load.
c) Poor contact of the brushes, defective springs (too loose or broken) or the pressure device tip is not in the corresponding groove of the brush.	Correct the brush contact, replace the defective brush holder, adjust the pressure device tip properly, etc.
d) One or more sections of the armature are burned.	Replace the electric machine by a spare one.
e) The commutator risers are unsoldered.	Repair the armature or replace the electric machine.

Part IV

INSTRUCTIONS ON DISASSEMBLY, ASSEMBLY, CONSERVATION AND DECONSERVATION

A. Disassembling the Machine

1. Disconnect all the leads from the machine.
2. Release the shaft ends, remove the coupling or pulley.
3. Remove the cover bands, open the lids and place a pressboard between the armature lamination and the lower poles.
4. Unscrew the bolts at the commutator end fixing the bearing casing to the face washer and the bearing housing bolts.
5. Remove the bearing housing at the commutator end.
6. Remove the brushes from the holders, detach the cables from the rocker.
7. Loosen the rocker bolt, remove the rocker, wrap the commutator in pressboard.
8. Remove the armature with housing from the magnetic system.
9. Remove the housing from the free end of the shaft.
10. Place the armature on a wooden bench or trestle, suspending the fan and protecting it against damage.

B. Assembling the Machine

Assembly is carried out in the order reverse to disassembly.

Before assembly make sure that all parts of the electric machine are in good repair and clean; correct the defects discovered.

Preparation for starting should be carried out according to the instructions listed in part III, section C.

C. Conservation

Before placing the machine in dead storage carry out the following instructions in addition to those listed in part III, section G:

1. Disconnect the electric machine from the mechanism;

2. Cover the couplings and the free shaft ends with special varnish or gun grease;

3. Fasten the spline in the spline groove at the free end of the shaft with a copper wire;

4. Cover the threaded part of the free shaft end with vaseline, the remainder of the shaft with special varnish and screw on the nut. Then wrap the end in sackcloth and also coat it with varnish. To protect the machine against dust cover it with canvas.

The ambient temperature of the storage room should not drop below +5°C with the daily variation of +10°C and humidity not exceeding 75 per cent.

The storage room should be free of fumes, acids and alkali, gases and coal dust. Check the machine for safe conservation and correct all the faults found.

When the machine is kept in dead storage for over a year it is subject to inspection.

D. Deconservation

The procedure of deconservation is reverse to that of conservation. All parts covered with vaseline, gun grease and varnish should be wiped with rags soaked in petrol, then with dry clean cloth and finally blown by dry compressed air. Oil the shaft end and the boring of the coupling hub, fit the coupling onto the shaft and couple the machine with the mechanism. Repair or replace all the defective parts found.

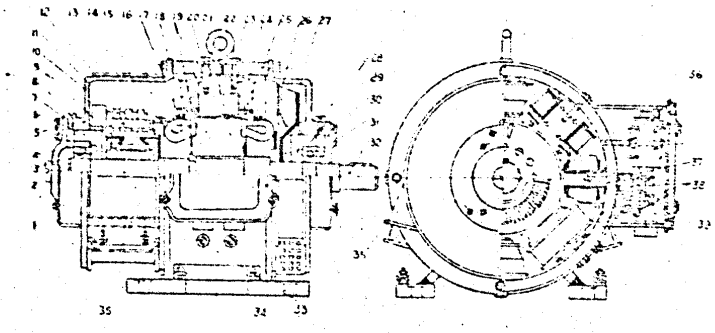


Fig 1 General view and section PN-10

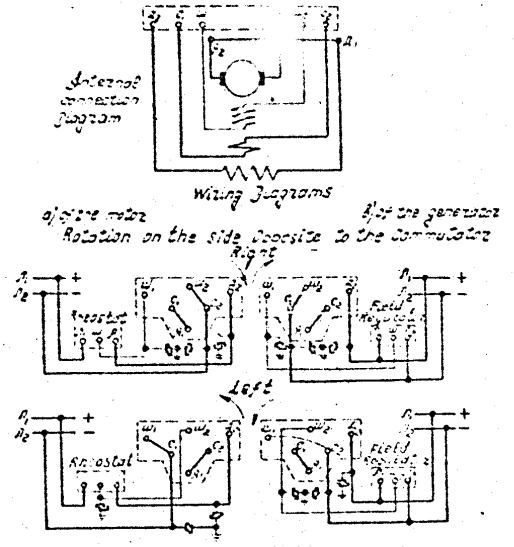


Fig 2. Diagram of the winding internal connections

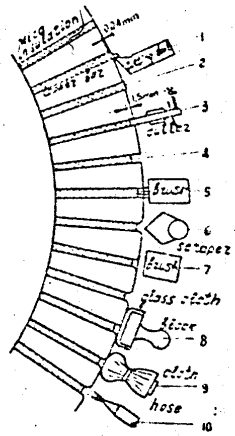


Fig. 3. Commutator Maintenance

1. When the commutator eccentricity exceeds 0.04 mm turn or grind the commutator.

2. After long operation the mica insulation juts out.

3. Groove it 1.5 mm deep with a cutter 0.8 mm wide (cutter diameter - 20 mm).

4. Incorrect grooving: too deep, carbon dust bridges are possible.

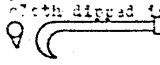
5. Incorrect grooving: too narrow, mica projects at the segment edges, strong sparking is possible.

6. Chamfer the edges of the commutator bars with a special scraper (see drawing).

7. Grind in the brushes to the commutator with glass paper (abrasive side toward brushes). Then grind in the brushes to the rotating commutator.

8. Grind the commutator with a block shaped to fit the commutator curvature.

9. Clean the commutator with cloth dipped in solvent or petrol.



10. Blow the commutator by dry compressed air with the brushes lifted.

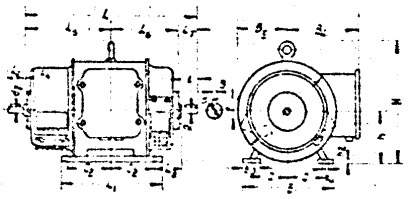


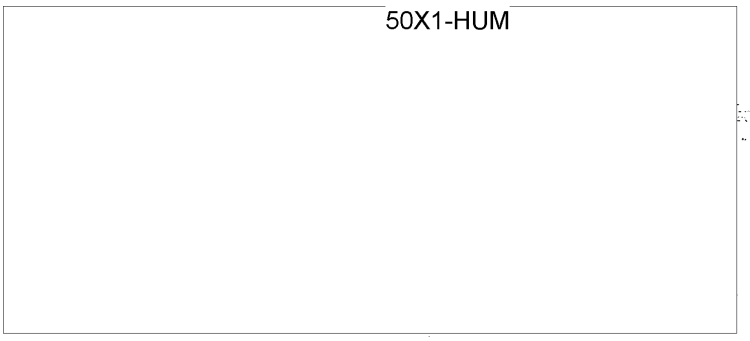
Fig.4 Overall Dimensions of type PN-10 machine

Dimensions in millimeters												
L	L_1	L_5	L	L_7	L_8	l	l_2	l_4	B	B_3	B_2	B_5
494	260	243	188	63	81	50	50	6	262	50	208	139

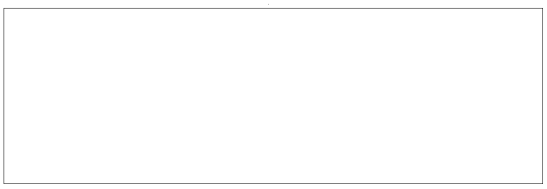
Dimensions in millimeters											GD^2 kgf/m²	weight kg
b	c	c_2	D_1	d	d_2	d_3	H	h	h_2	s_1		
6	105	120	270	20	20	15	317	140	12	22,5	0,08	72

ERRATA SHEET

Page, line	Printed	Should read
p. 4, 1st from bottom	impregnated by	impregnated with
p.6, 4th from bottom	0.5 megohm	0.5 megohm
p. 9, 6th and 5th from bottom	by a hand bellows	by hand bellows



MAINTENANCE RULES
FOR AUTOMATIC STARTER KP I-Д



MAINTENANCE RULES FOR AUTOMATIC STARTER KP I -Д

GENERAL

The automatic starter KP I-Д is designed for remote starting, underload-overload protection of shunt-wound and compound-wound motors, for driving various supply units.

The remote control of the starter is effected with push buttons. For more reliable operation the starter is provided with a hand-operated emergency drive.

The following technical data of the starter are given on the name-plate :

1. Type
2. Working voltage
3. Rated motor current intensity
4. Starting resistance value in ohms
5. Motor starting load with respect to rated
6. Type of unit and motor capacity for which the startor is designed
7. No. of the winding data of resistors and coils.

Control

The automatic starter KR I-Д is designed only to start and stop the motor.

The system operates in the following way (see diagram I)

Upon pressing the "start" button the acceleration contactor shunt coil КУш circuit closes. The acceleration contactor КУ operates breaking its main contact and closing

its retaining - contact. Through the closed retaining-contact KУ the voltage is impressed upon the coil of line contactor КЛ.

The contactor КЛ operates closing with its main contact the shunt winding and the motor armature circuits. The current starts to pass through the armature. The current is limited by the starting resistor ПС in the armature circuit. When the contactor КЛ operates, its normally closed retaining contact opens.

The retaining contact КЛ opens after the main contact begins close. At the same time the circuit of the shunt winding УШ opens and the acceleration contactor is maintained in the working position by the series coil КУс series-connected into the motor armature circuit.

The motor begins to accelerate producing back electromotive force which reduces the current in the armature,circuit. When the current drops to the acceleration contactor setting current, the series coil КУс releases its armature the main contact of contactor КУ closes and shunts the starting resistor ПС. By this time the motor attains its rated speed.

Contactor КЛ remains out in for the entire period of motor operation provided the voltage impressed upon its coil is sufficient.

The "start" button should be kept pressed for I-2 seconds until the КЛ main contact closes.

To stop the motor push the "stop" button. At this moment contactor КЛ is cut off thus breaking the motor circuit.

When hand-operated the starter handwheel should be turned clockwise from the "stop" to the "start" position halting in the intermediate position for 4-5 seconds.

To stop the motor, quickly turn the handwheel to the "stop" position on the scale.

Underload Protection

Underload protection of the motor is provided by contactor KM. When the voltage drops to 25-65 per cent of the rated value the contactor opens and breaks the motor circuit.

Hand-operated (emergency) control has no underload protection.

Overload Protection

Overload protection is afforded by overload relay PM. The relay coil is connected into the circuit of the motor armature. When the current intensity in the motor armature circuit exceeds its rating the relay armature is attracted. Its contacts open the coil circuit of contactor KM and out off the motor from the mains. The current intensity at which the relay is cut off is given on its scale.

Temperatures

The automatic starter KP I-II is not designed for frequent startings. The starting resistor as far as heating is concerned is so rated that it can stand five startings of the electric motor during five minutes provided the voltage in the circuit is normal and the duration of one starting cycle is one minute.

Besides, the starter can stand startings of the electric motor regularly repeated every five minutes. Under such conditions the stabilized overheating of the starting resistor does not exceed 300° C, and the overheating of the casing, 90° C.

Maintenance Rules

Faultless operation of the starter depends not only on correct handling but also on proper observance of the maintenance rules. The starter must be inspected regularly and, at any rate, at least once a month. The inspection is possible only after :

a) the feeder cable voltage is cut off;

b) the cover and the side frame are removed;

c) the leads are disconnected from the starter.

To remove the cover and the side frame of the starter unscrew nuts fixing the cover. Do not remove the starter handwheel as it does not hinder disassembly of the casing.

The spring pressure should not be changed without necessity as it is adjusted at the plant-producer. The change of the spring pressure can result in improper work of the contacts and hand operated (emergency) control.

During the inspection the following measures should be taken :

Hand-operated and contactor control-board.

Wipe dust and dirt from both sides of the board.

The fixed contacts and contact brush should be cleaned

by a barette file if oxide, cookerels or beads appeared. When cleaning try to preserve a regular shape of the contact surface approximating its original shape . After the contacts and the brush are cleaned and the latter is installed in its place test its pressure on the fixed contacts. This pressure should be within the limits indicated in table I.

When the spring pressure largely differs from the table data and adjustment of the given spring is impossible, replace the spring by a spare one.

Check the tightening of the clamp screws and contact connections and, if loose, tighten the nuts.

If the contact surfaces of nuts or washers are oxidized, disassemble the clamp screw, clean the oxidized surfaces with a barette file, wipe them dry and then reassemble the clamp in the same order.

Contactor KI and KV and Relay PM

Inspect the contacts and, if oxide or beads are found, clean them with a barette file. When cleaning try to preserve the original shape of the contacts and to provide their contact along their entire width (at least 75 per cent of it). The contactor retaining contacts and those of the overload relay should not be cleaned. If burned or scoted wipe them clean with a rag slightly soaked in benzine.

If the contacts are so strongly burned that the clearance

"A" between the moving contact and its support (Fig.2) is narrower than that indicated in table I,the contacts should be replaced.

The contacts should always be dry,their oiling is forbidden.

After cleaning or replacing the contacts adjust the pressure between them to bring it within the limits indicated in table I.

The contact pressure is measured in the following way: a loop of thin wire or strong thread is put on the moving contact as close as possible to where it touches the fixed contact. A slip of thin tissue paper is inserted between the moving contact and its support. Then the loop is hooked to a dynamometer, and, pulling the dynamometer with one hand and the paper (slightly) with the other, note the reading of the dynamometer at the moment the paper is released and begins to move freely (Fig.3).

Inspection, cleaning and replacement of the contacts should be performed without removing the contactor armature and without altering the setting of the disconnecting spring.

Inspect the place of contact of the contactor armature and core, remove all dirt and rust and then wipe it with a rag with a thin layer of non-acid vaseline.

In case the disconnecting spring slackens or if a necessity arises to remove the armature, to replace, for example, the

sucking coil, the apparatus should be adjusted in the following way :

a/ Overload Relay Adjustment

Connect the relay coil to the mains or a generator via a separate rheostat and, with its help, set the current intensity necessary for the relay to trip. Then adjust the disconnecting spring in such a way that the relay armature is attracted at the specified current. The operation of the relay with the spring so adjusted should be tested by 10-20 fold switchings.

b) Contactor KT Adjustment

Shunt the KV retaining contact and connect a source of regulated voltage to terminals 16 and 5. Adjust the disconnecting spring of contactor KT in such a way that the contactor trips at 50-60 per cent of the rated voltage. Then connect the source of voltage to terminals 16 and 13 (upper terminal of economizer resistor) and, having raised the voltage to the upper limit (corresponding to the working conditions of the starter), press by hand the contactor armature to the core. Then remove the hand and, slowly lowering the voltage, determine the voltage at which the contactor armature is released.

This voltage should be about 25-26 per cent of the rated. When disassembling the contactor see that the non-magnetic washer is installed in its place.

Adjust the retaining contact KT in such a way that it trips after the closing of the KT main contact.

Adjustment completed, remove the jumper shunting the KV retaining contact.

c) Contactor KV Adjustment

Connect a series coil via the separate rheostat to the mains or to a generator and, with its help, set a definite current intensity of the contactor. This current in KP I-Д -3 should be equal to five rated currents of the motor. Press by hand the armature to the core and then remove the hand.

Then rapidly but smoothly reduce the current in the circuit of the series coil until the armature is released. The current at which the armature is released is achieved by adjusting the disconnecting spring. After the spring has been adjusted according to the current at which the contactor makes a release, the voltage at the series coil terminals lowered and removed by means of the rheostat. The adjusted voltage is impressed upon terminals I6 and 7 and the closing of the contactor is checked up to 70 per cent of the rated voltage. If the contactor with the adjusted spring according to the release current does not close the circuit, replace the spring.

All voltage values for closing and opening the contactor are given for a coil operating at temperatures 20-25°C. Therefore do not keep the coil long under current, which especially applies to coil KVm.

When adjusting the contactors disconnect the motor from the starter.

Resistor

When inspecting the resistor see that the terminals on the resistor elements and those of the terminal board connected to the resistor are not loose, and in case they are, tighten the nuts.

See that there is no turn-to-turn short circuit in the resistor elements, no contact between non-insulated junction wires or between them and the resistor elements along which they run, and also between the wires and the rheostat body.

Replace the burned resistor element by a spare element of the same type. The clamp stirrups on the spare element should be placed in the same position as on the replaced element.

After inspecting and repairing the starter, wipe all dust and metal filings and install the spark extinguisher chamber in its place. Before installing the cover set the contact brush in the extreme left position and put the handwheel on the cover in the same position.

In this position of the brush and the handwheel the cover can be easily installed and the handwheel is properly engaged with the contact brush. After installing the cover and before tightening the nuts, see if the handwheel easily moves along its entire working path. If the handwheel moves with difficulty and unevenly first do away with all displacements and only after that tighten the nuts fixing the cover.

Table I.

Contactor				Brush
Type	Span of contacts "B" in mm	Clearance "A" with new pin, mm	Clearance "A" at which the pin must be replaced	Initial pressure, kg	Brush pressure, kg
KI	7±1	2.75+0.5	I.5	0.II± IO per cent	0.6—I
	7±1	2.75+0.5	I.5	0.364±IO per cent	

Connection Diagram of Automatic Starter KP 1-K -4

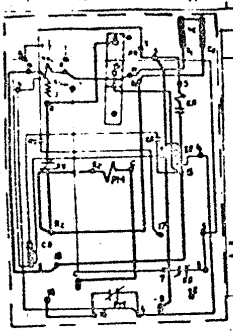
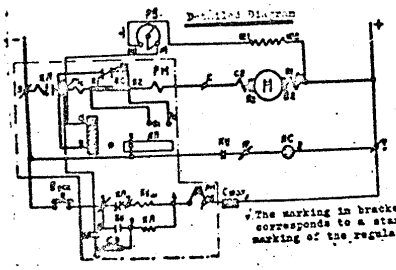


Diagram Elements

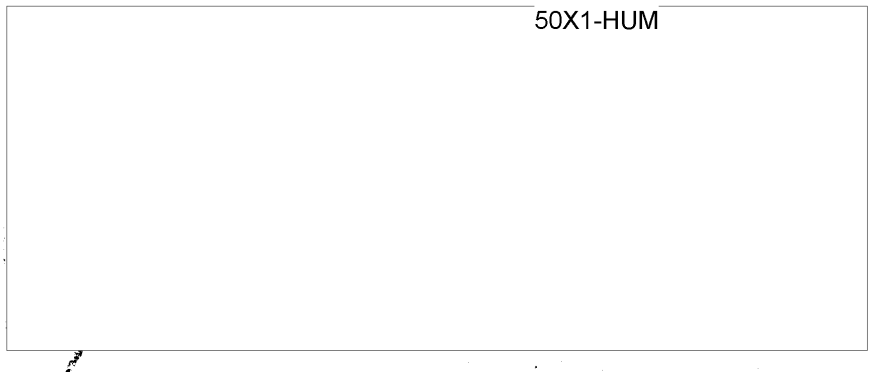
Symbols	Name	Type
КЛ	Line contactor	КЛМ 200 АМ
КУ	Accelerator contactor	КЛ- Б
КУо	Series coil	К-ра КУ
КУш	Shunt coil	
АП	Emergency starter	Hand-oper
ПС	Starting resistor	
СЭ	Econom.resistor	
РМ	Overload relay	
М	Motor	
РВ	Excitation regulator	
"start"пуск "stop" стоп	Push buttons	
ЛС	Signaling lamp	



Detailed Diagram

* The marking in brackets corresponds to a standard marking of the regulator.

Fig.2 Fig.3



POWER PLANT, TYPE D-13-VII
DESCRIPTION AND INSTRUCTIONS

CONTENTS

1. GENERAL

Power plants, type D-13-VII are designed for supplying apparatus with direct current of several voltages. Each power plant serves at one and the same time as a source for feeding the anode, the grid and the filament circuits of valves.

Power plant D-13-VII is a one-case machine, consisting of a d.c. driving electromotor, of a d.c. two-commutator high voltage anode generator (type DA-13-VII) to feed valve anodes and of a d.c. grid-filament generator to provide high voltage for the grid bias and, at the same time, low voltage for the filament circuit. All the three are housed in the same case.

The generators and the motor of the power plant have independent magnetic systems mounted in a common case. The armatures are fitted on a common shaft.

Ratings of generators of all power plants are the same. Power plants differ only in the driving electromotor voltage. Power plants D-13-VII are equipped with d.c. 110 v or 220 v motors.

The anode generator is a two-commutator direct current high voltage generator. The generator has two independent armature circuits, connected with their respective commutators. The voltage on the commutators is the same.

The commutators are connected in series. Thus, it is possible for the generator to supply the load both with one commutator voltage and with two-commutator voltage i.e. with the aggregate voltage of the two commutators.

The grid-filament generator is a D.C. high and low

voltage generator with independent windings of the armature and of the commutator both of low and of high voltage. Excitation circuits of the grid-filament and of the anode generators are supplied with the low voltage of the grid-filament generator. The anode and grid generators allow intermittant load operation provided there is protection of the high voltage circuits of the armature with appropriate stopping condensers.

The power plants D-13-VII allow normal operation at considerable fluctuations of the supply mains voltage without regulation of rotation speed. They are equipped with automatic starters for automatic remote control or manual starting and stopping.

The grid-filament generator low voltage is adjusted by means of an automatic regulator.

The power plants are of watertight design. All machines have moisture-resisting insulation. The power plants have ball bearings No. 207. They are also provided with self-ventilation, i.e. they are cooled by means of two ventilators set on the two ends of the shaft.

The power plant inspection covers placed opposite the anode and grid-filament generator high voltage commutators have blocking systems, which switch off the generators' excitation when any one of the covers is opened. To protect the generators' excitation windings against overvoltage in case of excitation circuits breakage, these windings have

protective resistors, type 1 (25 ohms).

The power plants D-13-VII are mounted on shock-absorbers, which enable the power plant to work in a horizontal position, when inclined to 45 degrees, and when suspended.

The power plants have radio interference filters, to reduce radio interference that arises during operation.

Overall and erecting dimensions of the power plant are given in fig. 1.

The power plant has clockwise rotation (looking from the motor side).

The component schedule of the power plant set is given in Table 1, the ratings, in Table 2.

TABLE 1

Component Schedule of the Power Plant Set

Item	Name	Type	Weight (kg)	Quantity per set
1	2	3	4	5
1.	Power plant	D-13-VII	150.0	1
2	Anode generator excitation rheostat	P-45-5	3.0	1
3	Grid-filament generator excitation rheostat	P-45-5	3.0	
4	Case with spare parts and tools	-	10.0	1
5	Description and operating instructions	-	-	1
6	Radio interference filter	4	-	1

1	2	3	4	5
7	Automatic starter with starting knob	KP-1	-	1
8	Starter - description and operating instructions	-	-	1
9	Automatic voltage regulator	PYH-111	-	1
10	Regulator rheostat	-	-	1
11	Regulator - description and instructions	-	-	1

TABLE 2

Ratings of Power Plant Machines for Long Duty

Machine	Type	Current	Power (KW)	Voltage (v)	Strength of current (A)	RPM
Electro-motor	DM-13-VII	d.c.	2.2	110/220	25/13	3,200
Anode generator	DA-13-VII	d.c.	0.9	750x2	0.6/0.6	-
Grid-filament generator	DCH-13-VII	d.c.	0.9 0.336	600 21	0.15 16	-

NOTES:

1. Two values of voltage for electromotor means that the motors are produced, in compliance with the order, for one of the two given voltage values. According to the two voltage

50X1-HUM

values there are given two values of the strength of current.

2. Figure "2", which stands for the anode generator voltage, indicates that the generator has two commutators, the voltage denoted by the figure before "2" stands for the output voltage.

The commutators are connected in series.

3. Two figures for the anode generator strength of current mean that both commutators' output current is 0.6 A.

4. Double values of power, voltage and current strength for the grid-filament generator indicate that the generator has two independent armature circuits and two commutators, which produce different currents at different voltages.

5. The grid-filament generator rated current of 16 A is the load current, it does not include the currents used for the generators and automatic regulator excitation.

6. The power plant allows long duty within the ratings at an ambient temperature of +40°C. At higher temperatures only short time operation is permitted.

The d.c. electromotors allow operation at considerable variations of the voltage from the rated value.

Duration of the power plant operation at various variations of voltage and the permissible ranges of variations from the rated value are given in Table (3 see page 6).

The generators render it possible to obtain the rated performance within the indicated ranges of the mains voltage variations.

The winding data of the power plant machines are given in Appendix 1.

The connection diagram of the machines is given in Fig. 2.

The system envisages blocking only of the power plant covers providing access to the high voltage commutators. The blocking circuits are directly connected to the excitation circuits by means of cross-members on the power plant terminal panel. The filter cover blocking is included in the common blocking circuit. Connection of the excitation and blocking circuits is effected after the filter through cross-members on the output terminals.

To include the transmitter blocking circuits in the common blocking system it is necessary to connect them in series with appropriate aggregate blocking circuits, instead of the cross-members, which in this case, are not set up.

The voltage drop in the excitation circuits (in junction wires and in retaining contacts) should not exceed 1 v.

TABLE 3

Mains voltage (volt) for 110 v electromotors		Mains voltage (volt) for 220 v electromotors		Operation duration
from	to	from	to	
95	105	175	205	1 hour
105	132	205	258	unlimited
132	154	258	300	1 hour
154	170	300	320	20 minutes

II. DESCRIPTION

Direct current Electromotor

The motor, type DM-13-VII, is a shunt-excited direct current motor. Starting of the motor is effected through the automatic starter, type KP-1.

The motor has no speed regulation.

Anode Generator

The anode generator, type DA-13-VII, is a two-commutator high voltage direct current generator. Two windings connected to the respective commutators are placed into the slots. The voltage taken from each commutator equals 750 v.

The lower winding placed on the slot bottoms is brought to the commutator which is on the grid-filament generator side (in the diagram in Fig. 2 it is designated by "II"). This armature circuit is brought to the terminals $+Я_2$ and $-Я_2$ The rated continuous load current of the circuit is equal to 0.6A.

The upper winding is brought to the commutator on the rotor side (the motor is designated in the diagram in Fig. 2 by figure "1") Terminals $+Я_I$ and $-Я_I$ correspond to this circuit. The rated continous load current of the circuit is equal to 0.6A.

Both circuits are connected in series, as can be seen from the diagram. The generator is compound - excited. Independent excitation is supplied from the grid-filament generator

low voltage of 21 v. The compound winding limits the magnitude of the voltage variation at the load-shed within ±7% of the rated voltage value.

In practice, the sparkless commutation of the machine is provided by the auxiliary poles. To reduce radio interference, caused by the generator operation, the auxiliary pole and compound winding coils are divided into two groups, each connected to one of the armature circuits.

The generator voltage is adjusted with the rheostat P-45-5, connected into the independent excitation circuit.

The generator has two additional terminals, marked with the letters "C" to dry the generator at short circuit conditions without exciting the poles. As is seen from the diagram, closing of these terminals by means of a cross-member makes it possible to short the armature winding and auxiliary poles' circuit, without connecting into the short circuit, the compound winding of the main poles.

Grid-Filament Generator

The grid-filament generator, type DGH-13-VII is a d.c. two-commutator generator. Two windings connected to their respective commutators are embedded into the slots of the armature. The lower low-voltage winding is connected to the commutator on the ball bearing shield side. It is brought to the terminals $+Я_H$ and $-Я_H$ their output voltage being 21 v at the load current of 16 A. The upper winding is connected to the commutator on the anode generator side. It is brought

to the terminals $+f_0$ and $-f_0$ whose output voltage is 600 v at the load current of 0.15 A.

The generator is compound-excited. Shunt excitation is supplied from 24 v low voltage. Apart from shunt-excitation there is a magnetisation winding connected in series with the motor armature circuit and supplied with the motor current. It is placed on the generator poles.

The low voltage of the generator is adjusted and maintained stable, regardless of the load and rotation speed, by means of the automatic voltage regulator. Owing to the common magnetic system, the high voltage is adjusted simultaneously with the low voltage.

If the automatic regulator gets out of order the generator voltage is to be regulated by hand.

Automatic Voltage Regulator

The automatic voltage regulator is designed for automatic adjustment of the grid-filament generator low voltage. It provides stability of the low voltage accurate to 2% from the average voltage value, regardless of the load and rotation speed.

The principle of the regulator operation and rules for its use are given in a special description, which is supplied together with the regulator by the manufacturer. The regulator dimensions are given in fig. 3.

R h e o s t a t s

Rheostats, type P-45-5, inserted in the independent excitation circuit of the anode generator and in the shunt excitation circuit of the grid-filament generator are designed for manual adjustment of generator voltage.

This is the only way of adjusting the anode generator voltage.

For the grid-filament generator the rheostat adjustment is a make-shift one (in case of automatic regulator failure).

Connection diagrams of the rheostat are shown in Fig.4.

Dimensions of the rheostats are shown in Fig. 5.

In both cases the clock-wise turning of the rheostat hand-wheel (from the commutator panel side) corresponds to the increase of the generator voltage.

Automatic Starter for D.C. Electromotor

The automatic starter for the d.c. motor, type KP-1, is designed for automatic distance control or manual starting and stopping of the power plant.

Besides, the starter automatically cuts off the power plant when the supply mains voltage drops too low, and also in case of an impermissible increase of the motor current.

Ratings of the starter, its operational principle and rules for use are given in a special description, supplied by the manufacturer together with the starter.

Radio Interference Filter

The filter equipment of the power plant is employed to

reduce radio interference, caused by the operation of the power plant machine. The filter reduces the interference to a level, which permits reception during the operation of the power plant.

All the units of the filter are mounted on a common base, fastened on the machine body, and have a common cover. All the lead-out wires of the power plant pass directly to the filter box. Radio-interference protection is carried out up to the outside terminals. It is effected through series connection of chokes into the circuits and through earthing of the conductors through condensers. Some low-voltage circuits are protected by means of condensers only.

The connection diagram of the power plant D-13-VII filter is given in Fig. 2.

The filter is protected by a waterproof cover. The cover has retaining contacts; when the cover is removed, the generator excitation circuits are broken.

To protect the machines from short-circuit the high voltage circuits of the anode and grid-filament generators (directly after the lead-out of the conductor from the machine to the filter) have 0.6A. safety fuses for the anode circuits and up to 0.25 A fuses for the grid generator circuits.

The fuses are set in the filter box.

Tools Case

A case with tools for disassembling and assembling, and with spare parts for the power plant and the apparatus (ball

bearings, brushes, brush-holders, brush-rockers) is attached to the power plant.

III. OPERATING INSTRUCTIONS

Mounting

While mounting it is necessary to provide the supply of cooling air in such a way that the heated exhaust air does not mix with the suction air.

The inlet and outlet ventilator holes are protected with grates. While mounting see that no dust, foreign bodies or moisture get into the machine.

Access to the inspection covers should be provided so as to facilitate the inspection of the brush mechanism and the commutators.

For mounting the automatic voltage regulator choose a place that is protected from dust. At the same time the place should ensure good cooling of the regulator.

Switching-On

The switching-on diagram of the machine and of the apparatus of the power plant D-13-VII is given in Fig.6.

Switching-on of the protective resistors and of the stopping condensers is not shown in the diagram.

The system provides normal operation of the grid-filament generator with the automatic voltage regulator, whose carbon resistor is connected in series with the shunt excitation

circuit.

Rheostat P-45-5 is connected into the anode generator independent excitation circuit.

In case of regulator failure a rheostat is also connected into shunt excitation circuit of the grid-filament generator. Normally when operating with the voltage regulator, this rheostat should be shunted. However, despite the shunting of the rheostat, when the regulator operates, the rheostat handwheel should be in the position corresponding to the fully switched-on resistor.

In case of the automatic voltage regulator failure and of the necessity to operate with the grid-filament generator rheostat the switching-on differs from that shown in Fig. 6 in that the regulator is disconnected from the rheostat and from the terminal panel, and the cross-member between the rheostat terminals is removed.

It is possible to resort to operation with the rheostat without the automatic voltage regulator being cut out. For this, it is necessary to remove the cross-member between the rheostat terminals and to shunt the carbon resistor of the regulator with a cross-member between the corresponding regulator terminals.

Preliminarily check the position of the rheostat handwheel, since at the moment of unshunting the rheostat resistor should be cut in fully.

The motor must be protected with fuses. The fuses should...

also be set in all load circuits to ensure a reliable opening of the generators in case of over-load or short-cicuit. The fuses should be inserted as near the power plant as posseble. No apparatus should be connected into the circuit between the fuses and the machines. The fuses in the generator high-voltage circuits are installed in the filter box, but they protect the machine from short-circuits only.

Knife-switches to cut in or out the load should be inserted in all load cicuits.

Starting. Adjustment. Stopping.

Power plants allow starting with the grid-filament generator low voltage load switched on.

Before starting, the anode generator rheostat handwheel should be turned counter-clockwise to its extreme position.

In operation without the voltage regulator the rheostat handwheel of the grid-filament generator should be turned counter-clockwise before starting, i.e. it should be set into the position of the fully switched-on resistor.

Starting of the power plant is effected by means of starting of the motor with the automatic starter.

The grid-filament generator voltage is set and adjusted automatically.

The brush of the voltage regulator series rheostat, when the regulator is tuned should be set into the position, in which the voltage kept up by the regulator is equal to the rated low voltage of the grid-filament generator and in

further operation this position of the brush is never changed. The position is corrected only in case of tuning derangement.

The anode generator voltage is set and adjusted with the rheostat.

In operation without the automatic voltage regulator the grid-filament generator voltage is also set and adjusted with the rheostat.

Stopping of the power plant is effected by means of stopping the motor (by switching off from the supply mains).

The power plant must operate with its covers shut. It is forbidden to operate with the covers open since this interferes with the ventilation of the machine.

All covers and inspection ports are numbered. The covers should be set in their places.

IV. MAINTENANCE

In operation it is necessary to observe the following rules:

Check the position of the internal connecting wiring; it must not touch the armature. There schould be no contact between the adjacent high-voltage commutator brush conductors either.

See that the machine is always clean. If much dust has been found in the machine, the power plant should be blown through. Take special care of the retaining contacts, clean them regularly.

Commutator

After every 80-100 hours of operation examine the machine commutators and wipe them with clean rags slightly wetted in benzine.

The machine commutators are grooved.

Therefore while examining the commutators check throughly for accumulated carbon and metal dust in the splines between the segments and for barbs on the segment edges, since these may cause a short-circuit of the two adjacent segments (resulting in a short-circuit in the armature winding and in possible generator failure).

Dirty splines are to be cleaned with a sharp wooden stick.

If scale is detected on the commutator, it should be cleaned with slight pressure at idle running with pumice-stone or with fine glass paper wrapped round a block. It is forbidden to press the paper to the commutator with the fingers.

It is also forbidden to grind the commutator with emery paper. Do not forget to reduce to zero the voltage on the high voltage commutators by switching off the excitation circuit before grinding.

Remember, that even with the excitation switchted-off, the voltage on the high voltage commutators reaches 100 v.

It is not necessary to grind the commutator if there is no scale on it. Take care not to mistake the film of varnish on the commutator for scale. This film of reddish-brown colour with a violet hue is not to be removed from the commutator surface.

After grinding check if there is dust or barbs in the splines. Remove the dust by wiping it off or by blowing it out of the machine (do not blow the dust into the machine).

In case of considerable scale or of re-scaling, find out and remove the cause of commutator sparking and scaling.

Small bead-wise sparking that does not deposit scale on the commutator is permissible.

To watch sparking during operation one should open the cover of the corresponding inspection port. To control the operation of brushes of the high voltage commutators under load with the cover open, it is necessary to close the blocking circuit, which was broken by removing the cover, by shunting the circuit with a cross-member on the power plant terminals. Caution: Remember that the commutator is under high voltage. Therefore by no means touch the brush mechanism, the brushes, or any other parts inside the machine for this is fatal. Brush sparking, followed by scaling all over the commutator, is usually a result of bad grinding-in of brushes, of light pressure of the brush-holder spring, of dirty commutator or of unfixed brush-rocker. If scale is detected only under one brush, it means, that either the brush got slackened in the clamp or the brush got jammed.

Sporadic scaling, appearing with time, at unstable operation of brushes accompanied by noise and sparking means that there is insulation protrusion. It may appear only after long operation, as the machines are produced with grooved commutators.

To do away with sparking, in this case, it is necessary from to take out the mica between the segments to the depth of about 1 mm by means of a special saw. First, take the armature out of the machine, groove the commutator and then take out the mica. After that, clean away the barbs from the segment edges with a fine file, place back the armature and grind in the commutator while running and with the brushes lifted.

Burning out of a number of adjacent segments is indicative of the commutator jagging, which can be done away with by turning the commutator on the lathe. However, the turning of the commutator on the lathe is to be resorted to as rarely as possible, only in case of real necessity.

Regular re-scaling of individual segments means that the brush-rocker has shifted from the normal position, shown by red markings. The brush-rocker stopping bolts should be well tightened.

Spot-like scaling of several adjacent segments on the commutator indicates that there is a break in the armature section or a short circuit in the armature winding. In the latter case there is local heating of the armature. To check lift the brushes of the unmoving machine, connect two commutator segments, placed at a distance of one polar pitch, set the current (10-20% of the rating) and measure the voltage between two adjacent segments along the commutator arc. A voltage increase will show the break of the section, a drop of voltage between the individual pairs of segments as compared with the rest of the segment pairs will indicate a

short-circuit.

Before checking, thoroughly clean the commutator, since dirt between the segments may be the cause of the short-circuit.

Brush Mechanism

After every 80-100 hours of operation it is necessary to check the condition of the brushes and the fastening of the brush-rocker. Worn-out brushes should be replaced with new ones of the same type. If the type of the brushes is changed the manufacturer does not guarantee trouble-free operation of the power plant. The types of brushes used are given in the machine winding data appended to this description.

The newly mounted brush should be ground in to the commutator with fine glass paper, with the glass side of the paper to the brush and with the other brushes lifted.

The brush is ground in by running the glass paper under the brush in the rotation direction. Be sure that the glass paper fits close to the commutator as is shown in Fig. 7a. Fig. 7b shows the wrong way of brush grinding.

After grinding clean away the dust, lower the brushes and let the machine run idle for some time. (Fig. 7a. and b.)

Bearings

Regularly examine the operation of the bearings aurally by applying the ear to the rod resting on the outside of the

bearings. Wheezing, knocking and impacts as well as heating of the bearing with a cold bearing shield, are symptoms of trouble and mean that the bearing should be replaced.

Once or twice a year change the lubricant in the bearing. Before doing so, remove the old lubricant by throughly washing the bearing in several changes of benzine, then fill 1/2 or 1/3 of the bearing cavity with consistent lubricant, type 1 - 13; and close the bearing with the washed covers.

It is necessary to strictly comply with all the requirements concerning the cleanliness of the bearings, and the lubricant and its containers.

Insulation

Regularly check the insulation resistance when the machine is operated in a damp room and dry the power plant if necessary. (A megger is the best means for checking insulation resistance).

Dry the power plant by all means before starting if after a long period of inaction, when it has been kept in an inappropriate place.

Insulation resistance of windings with regard to the body must not be less than:

- 1.5 megohm for high voltage windings of the generator DA.
- 1.0 megohm for high voltage windings of the generator DCH.
- 1.0 megohm for the rest of the windings and apparatus.

To dry the power plant the motor is started.

The terminals C_1 and C_2 of the anode generator, with excitation switched-off, are closed with a cross-member through a 0.6A. fuse (to short the terminals $+Я_1$ and $-Я_2$ is forbidden) and the generator is dried in the short-circuit conditions with non-excited poles.

The high voltage windings of the grid-filament generator are also dried in the short-circuit conditions with the excitation switched-off. The terminals $+Я_0$ and $-Я_c$ are cross-membered.

Before setting the cross-members, check if the brush-rockers on the grid anode generator commutators are set and fixed in the right way (see the markings).

The low-voltage circuit of the grid-filament generator operates without load when the load circuit is opened.

Power plants operate in the above conditions 2-3 hours; after which the insulation resistance is checked. If measurements show satisfactory results, pass to normal power plant operation.

Do not forget to remove the cross-member between terminals C_1 and C_2, check it before switching on excitation.

If the preliminary check-up shows that the motor insulation resistance is so low that the connection of the motor into the mains is impossible, it is necessary first to dry the inoperative power plant by a flow of heated air (the temperature should be not above 80°C).

F a u l t s

Here are the faults the machine develope most frequently.

Overheating of the machines may be caused by overloading. Overloading of the machines or prolonged operation under the rated conditions, at an ambient temperature above that mentioned in the notes to Table 2, or long operation with the covers open is forbidden.

Overheating of the commutator may be caused by dirt on the commutator, by its rough surface, by excessive pressure of the brush springs on the brushes or by considerable sparking. A dirty commutator should be washed with benzine, a rough commutator should be ground in with fine glass paper or with pumice-stone.

Pressure on the brushes is to be about 150gr per brush. Causes and remedies for sparking are given above.

The filament generator voltage fluctuations may be caused by poor contacts in the excitation circuit, by a dirty commutator or by derangement of the regulator tuning, which demands an increased damping. In the latter case, when the load vacillates, the filament generator voltage does not become stabilized at once but only after some swings.

Poor excitation of the grid-filament generator may be caused by a dirty commutator. This fault is removed by grinding of the commutator, if cleaning with a rag wetted in benzine does not help. If the generator does not get excited under load, switch off the load and excite it. For this purpose the system has special knife-switches.

If in operation with the rheostat (after switching off and re-switching on of excitation) the grid-filament generator does not get excited, it is necessary to turn the rheostat handwheel clockwise, gradually switching off the rheostat resistor to a position in which excitation begins. Then as the voltage increases, gradually switch on the rheostat so as to set the rated voltage.

The d.c. motor current fluctuations at a stable load, are caused by poor contact in the motor excitation circuit.

Unstable operation of the d.c. motor, great rushes of the current at small changes of the load signify a wrong position of the motor brush-rodker, which should be set by the markings on the body and on the brush-rocker ring.

Rules for Filter Use

There is no necessity to frequently examine the filter in operation. It is quite enough to check the reliability of contacts once a month.

After a long inaction period, especially if the power plant was stored in a damp place, it is necessary to check the insulation resistance of all circuits of the filter. Before doing so disconnect the filter from the power plant.

The insulation resistance of all circuits of the filter should not be less than 10 megohms.

Regularly check the reliability of the earthing. If the fuses are blown out, examine the external circuit, and, if there are no defects in it, replace the fuse by a spare one.

In case of re-blowing of the fuse, check for a short-circuit in the filter, and also check the condensers of the circuit where fuses are blown.

Condenser break-down will result in a decrease of the insulation resistance of the circuit. Replace the broken down condenser. If it is impossible to replace the condenser and one is faced with the necessity of continuing the power plant operation, disconnect that defective filter circuit and connect by a cross-member the corresponding end of the machine lead-out wire to the terminal on the panel.

Automatic Voltage Regulator and Automatic Starter

Operating rules for the automatic voltage regulator and starter are given in the instructions attached to them. Among the most frequent troubles of the automatic voltage regulator mention should be made of the cases when the voltage maintained by the regulator is off the rated machine voltage.

This means that the position of the series rheostat brush is wrong. This trouble is removed by adjusting the rheostat.

V. DISASSEMBLY AND ASSEMBLY

Brush-Rocker Turning

The commutator brush-rockers are fitted on the rings (1) (Fig. 8), whose outer surfaces press against the body.

To prevent the rings from bevelling they have screw-guides, which are placed along the body circumference and fitted into the ring recesses. The screws are designed for

guiding only, not for fastening. The rings are stopped by dpreading into the body. For this purpose the rings have slits, which are against one of the inspection ports.

In this place a ring has a taper countersunk bore entered by a conic pin. If the pin is tightened with a nut, the latter entering the bore, will press the ring against the body.

To turn the brush-rocker it is necessary to unscrew and release the nut by tapping on the pin, to lower it to a certain extent. After turning brush-rocker the nut should be tightened up again.

Ball Bearing Lubrication

To open a ball bearing it is necessary to unscrew bolts 8, to take off the screw cap 2, and after unlocking the stop, to unscrew with a special spannor nut 3, which fastens the ventilator on the spline.

Take off the ventilator by means of a special device consisting of studs, a clamp and a non loosable clamp screw the end has threaded holes to drive in the studs. The studs are clamped. Driving in the non-loosable clamp screw into the clamp, thrust against the shaft end, remove the ventilator. To thrust the screw against the shaft end there is a special washer in the tools case in order not to derange the shaft centring slot.

Having taken off the ventilator, remove the spline. Remove the front stuffing box cover (4) of the bearing, for this- unscrew and take out the three bolts (5), fastening the cover, also unscrew the nut of the stud, placed into the fourth hole

in the stuffing box cover.

If, during washing, there are detected any defects in the balls, the ball bearings should be replaced.

Ball Bearing Replacement

To replace a ball bearing it is necessary to take off the bearing shield first.

To remove any of the shields, preliminarily take off, as was mentioned above, the screw cap, the ventilator and the front stuffing box, then undo the three bolts (10), fastening the shield. Put a couple of these bolts into the threaded sockets around the horizontal diameter of the shield. The body has no holes opposite these sockets. Therefore, when driven into the sockets the bolts will be thrust against the body and by further driving in they will push off the shield from its lock.

After that it is possible to remove the bearing. For this purpose one should unscrew the nut (6) fastening the ball bearing on the shaft; first tap out the stopping washer (7), which is flanged into the nut groove, then take off the bearing by means of a special device used to remove the ventilator.

The studs should be driven into the slots of the bolts (5), which fasten the outside stuffing box cover to the inside one, take the studs with the clamp and, driving in non-loosable clamp screw into the clamp (thrust against the shaft end by means of a special washer), remove the bearing.

Removal of Armature From Body

To remove the armature lift the brushes on all commutators. Trap the commutators in pasteboard and tie them up with a string. Disconnect the conductors leading to the brush holders.

Turn, as was said above, the brush-rocker rings to a suitable position and, having loosened the bolts (9), fastening the brushrockers to the rings remove them together with the brush holders. The rings, which carry the brush-rockers, are not removed.

Remove both bearing shields, as was said above.

The ventilators and the outside stuffing box covers are removed together with the shields. Then it is possible to remove the armature.

While doing so, be careful not to damage the commutator surface.

Assembling

The assembling of the power plant proceeds in reverse order.

The armature is set in from the same side that it was removed from.

The brushes should be fitted carefully, without bevelling. Mind that it is forbidden to use anything but a wooden or a sledge hammer (the latter through a wooden piece) to fit the brushes into their places.

The bearing shields, stuffing boxes, ventilators, brush-rockers and all other parts are put into their respective

places.

The brush-rockers being mounted, their rings are turned back, set and fixed in their normal positions according to the markings.

All fastening parts should be fully tightened.

After assembling, check the armature free rotation by hand. It turns easily, if the power plant has been assembled in the right way.

After the assembling and the check-up connect the disconnected conductors, seeing that the contacts are good.

The brushes are put into the brush holders only after the completion of the power plant assembling. Then grind in the brushes.

S t o r a g e

Long inactivity in a damp place with sudden temperature changes is especially harmful for the machine insulation.

Power plants must be kept in a dry aired place, where the temperature should not be lower than +5C.

In case of long storage the machines should be conserved.

The commutators should be wrapped up in oil paper. The brushes should be lifted and taken out of the boxes.

Unpainted and non-current-carrying units of the machine should be greased.

Appendix 1

POWER PLANT D-13-VII MACHINES WINDING DATA

Type	Motor		Anode generator	Grid-filament generator	
	DM-13-VII		DA-13-VII	DGN-13-VII	
1	2		3	4	
Power, kw	2.2		0.9	0.336	0.09
Voltage, v	110	1220	750±2	21	600
Strength of current, A	25	13	0.6	16	0.15
RPM			3200		
Kind of current	d i r e c t				
	A r m a t u r e				
Number of slots	33		33	33	
Type of winding	w a v e				
Number of windings	1		2	1	1
Slot pitch	1 - 9		1 - 9	1 - 9	
Lamella pitch	1 - 50		1 - 83	1-50	1-83
Number of sections in a coil	3		5	3	5
Number of turns in a section	2	4	15	1	15
Wire, type	ПЭЛБО	ПЭЛБО	ПЭЛШО	ПЭЛБО	ПЭЛШО

1	2		3		4		
Diameter, mm	1.082 Par	1.08	0.8		1.56 2 Par		0.17
Armature resistance, ohm	0.21	0.84	107x2		0.04		170
Copper weight, kg	1.65		0.9		1.2		0.2
	Main Poles						
Pole clearance, mm	1.5		1.5		1.5		
Pole winding	Shunt		Independent	Series	Shunt		Series (also the motor 110v, 220 v
Number of coils	4		4				4
Number of turns in a coil	2200	3350	200	350	210	2.5	4.5
Wire, type	ПЭЛ-1	ПЭЛ-1	ПЭЛ-1	ПЭЛ-1	ПЭО	ПЭЛ	ПБД
Diameter, mm	0.49	0.38	1.35	0.44	1.68	3.28	2.44
						3.28	
Coil resistance, ohm	64	155	0 62	11	0.45	0.001	0.005
Copper weight per machine, kg	4.4	4.1	3.2	0.55	4.2	0.25	0.2
	Auxiliary Poles						
Under Pole clearance, mm	2		2				
Number of coils	4		4				

1	2	3	4
Number of turns in a coil	32 64	800	no
Wire, type	ПВД ПБД	ПЭЛ-I	
Diameter, mm	2.63 1.95	0.41	
Coil resistance, ohm	0.023 0.075	19	
Copper weight per machine, kg	1.4 1.4	0.96	no
	Commutator		
Number of brushes per machine	8	8	8 4
Type of brushes	ЭГ-4	ЭГ-2	ЭГ-4 ЭГ-2
Brush size, mm	8x9	6x9	6x9 6x9

50X1-HUM

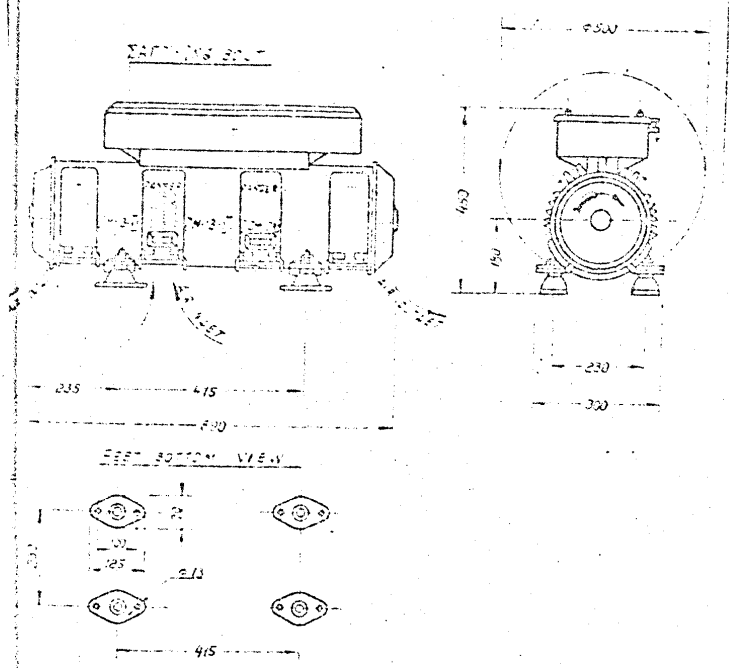


FIG 1.

50X1-HUM

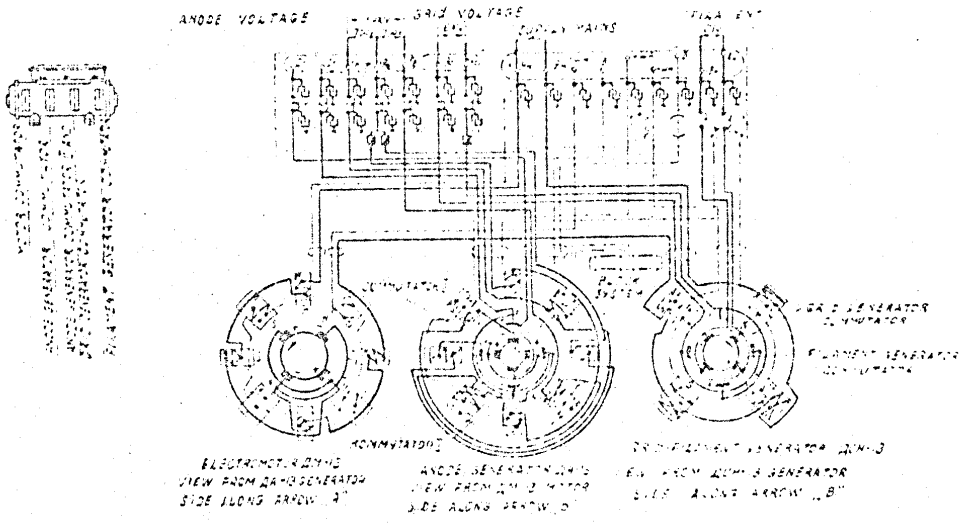


Fig 2

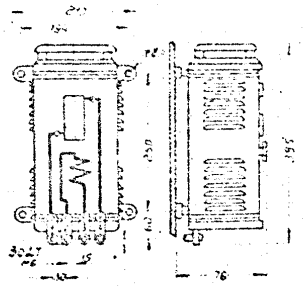


FIG 3 DIMENSIONS AND CONNECTION DIAGRAM OF REGULATOR TYPE 111

FIG 4 CONNECTION DIAGRAM OF RHEOSTATS P-48-5

(VIEW FROM COMMUTATOR SIDE)

50X1-HUM

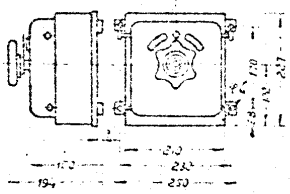


FIG. 3 DIMENSIONS OF RHEOSTAT, 0-25-5

50X1-HUM

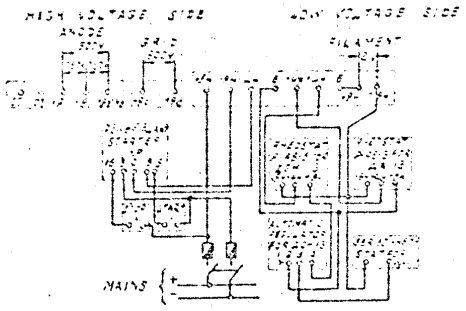


FIG 6 POWER PLANT MACHINE AND APPARATUS SWITCHING-ON DIAGRAM.

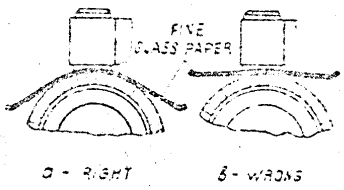


Fig 7

50X1-HUM

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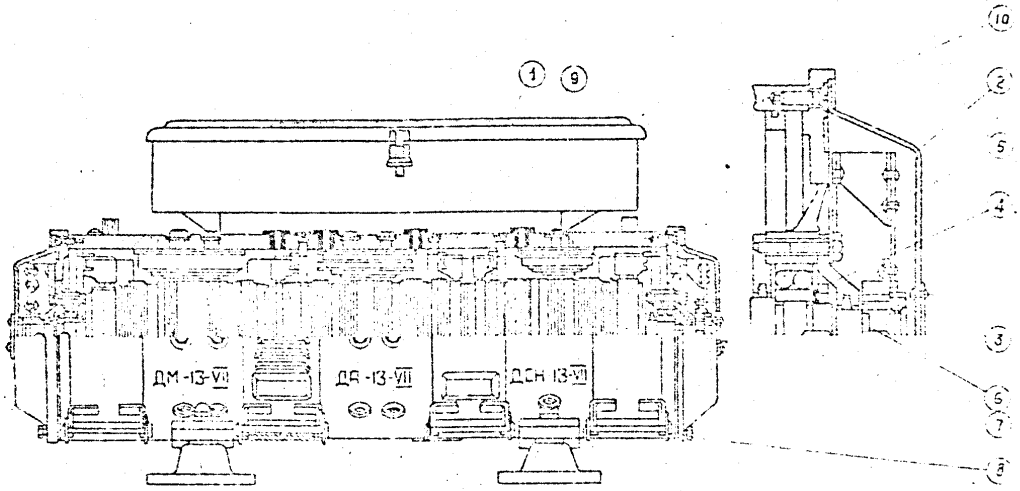

Fig. 8